

and fast lines of thought or operation, we are quite of opinion that those who make original researches, or are about to make them, may gain much from orderly methods of manipulation, and a knowledge of the right application of logical inference. Bacon attempted to describe such methods in his "Inquisitio de Forma Calidi," and failed, because at that time there did not exist a sufficient basis upon which to found an exhaustive experimental treatment of the subject.

Two interesting chapters in the first part of the book are devoted, the one to the facts and propositions in science, and the other to the criteria of scientific truth. We are reminded herein of an interesting treatment of these subjects in the "Philosophie Méthodique" of M. de Strada, to which we venture to refer our author.

Among the conditions of success in research Mr. Gore very justly enumerates enthusiasm. Of this he quotes several examples. Becher, of Phlogiston fame, after speaking of the chemists as "a strange class of mortals impelled by an almost insane impulse to seek their pleasure among smoke and vapour, soot and flame, poisons and poverty," adds: "Yet among all these evils I seem to myself to live so sweetly, that may I die if I would change places with the Persian King!" The fascination of original research is undoubted, the enthusiasm which it sometimes inspires is unbounded. We remember an instance of a schoolboy who seriously proposed staying at school for several days at the beginning of the Christmas holidays, when "home, sweet home," is doubly sweet, in order to continue a research. And truly, were it not for the enthusiasm which it engenders, the amount of original work done in the world would be much less than it is, seeing that it is usually accompanied by numberless vexations and disappointments, and that it requires unwearied application and perseverance, joined to the possession of an undaunted spirit.

Of Mr. Gore's work as a whole we may say that it exhibits great industry in the collection of facts and a considerable amount of logical acumen in their discussion. Perhaps, however, the arrangement might be simplified. The mass of matter to be digested is so great that any increased modes of classification of the subjects that could be adopted would add to the value of the book. This could best be effected by numbering the paragraphs; by adding marginal references giving the gist of each paragraph, and by making some of the chapters more aphoristic in character. These changes could be easily effected in a second edition.

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LEISURE-TIME STUDIES

Leisure-Time Studies; chiefly Biological; a Series of Essays and Lectures. By Andrew Wilson, Ph.D., F.R.P.S.E., &c. With numerous Illustrations. (London: Chatto and Windus, 1879.)

THIS volume of Essays and Addresses does not profess to contain anything new, either in the way of observation or theory. Neither is the author's style sufficiently brilliant, or his treatment of the subjects sufficiently original to raise them much above the level of the average lectures of a well-informed naturalist. They will, however, afford some useful and interesting

information to the general reader, and may serve to attract attention to the question of the introduction of biology into ordinary education. This is the special subject of the first address, which, however, though somewhat lengthy and profuse, does not attempt to grapple with the difficulty of finding competent teachers of biology for *all* our schools. It is indeed suggested, that "the amount of knowledge required to pass even the primary stage of the biological subjects, in the government examinations, held under the auspices of the Science and Art Department," should fit its possessor for imparting elementary instruction in biology. But we greatly doubt whether the examiners would be of this opinion; and we rather think it would be a distressing sight to witness a teacher, whose whole knowledge of the subject was derived from a course of study just sufficient to enable him to pass such an examination, exposed to the questions of a lot of intelligent country boys and girls, whose practical acquaintance with native plants and animals was far more extensive and accurate than his own. If biology is to be taught in schools it must not be by the regular school-teachers qualifying themselves by a few months' training in London, but by the employment of good naturalists to give lectures, demonstrations, and out-door excursions to all the schools of a district in succession.

In the succeeding address, on "Science-culture for the Masses," too much stress is laid on the teaching of science as "a pleasant system of mental gymnastics." This seems to us altogether a wrong ground to go upon. Science is not to be taught in order to strengthen the mind to do something else by and by, but because it opens the mind to a more adequate conception of the universe in which we live, and is in itself, truly, the knowledge which is power.

The lecture on "The Sea-serpents of Science" is interesting, both as giving a very fair summary of the most recent evidence on this subject, and as showing that the age of incredulity is past, and that naturalists are now prepared to admit that several distinct kinds of oceanic monsters probably exist, of which no single specimen has yet been obtained. Recollecting, however, the number of clever hoaxes to which this subject has given rise, we think that the newspaper account at p. 104, of the declaration before a Liverpool J.P., made by the master and crew of a merchant-ship, to the effect that they had seen a huge serpent twice coiled round a sperm whale, and a similar serpent with its head raised "sixty feet perpendicularly in the air," should not have been inserted as evidence without first ascertaining that such a declaration was actually made before the magistrate named. The trouble of writing a single letter would probably have been sufficient, and would have settled the preliminary question of whether the whole story, from beginning to end, was not a pure newspaper *canard*.

The article on "The Genesis of Life" repeats the now often-told tale of the fluctuations of opinion as to spontaneous generation, and will be interesting to those who have not read it elsewhere. Dr. Wilson tries his best to be impartial, and to place before his reader the exact position of the question at the present time. He acknowledges that "isolation" and "destruction" are the two great points of all experiments on the subject, and that if

these are perfect the question can be settled. It is not denied that hermetically sealed flasks give complete isolation, the only question remaining being, to secure complete destruction of whatever organisms, with their germs, may be within the flasks at the commencement of the experiment. He refers to Dr. Bastian's experiments on the death-point of minute organisms and their germs, which was invariably found to be 158° F., and he points out no fallacy in these experiments. Yet if they are conclusive, Dr. Bastian's numerous other experiments, confirmed as they are by Dr. Burdon-Sanderson and others, demonstrate the production of living organisms from dead matter. The elaborate experiments of Prof. Tyndall are referred to as giving results directly opposed to those of Dr. Bastian; but it is not sufficiently pointed out,—firstly, that in Dr. Tyndall's experiments "isolation" was not effected in the only perfect manner by hermetical sealing, and that many contradictory results hence ensued;—and secondly, that all the results opposed to those of Dr. Bastian were negative, and could therefore not disprove the latter's positive results. Dr. Bastian in his test experiments did not use "old hay," the germs in which are said to be "indurated," but infusions of turnip and cress, and after these were subjected in sealed flasks to temperatures of 270° F., and to 230° F. for upwards of an hour, they produced living organisms of such varied types as *bacteria*, *torula*, *protomaba*, and *monads*. ("Evolution and Origin of Life," p. 175-180.) As *similar organisms* and their germs, *produced in similar infusions* have been proved to be killed by a temperature at least 100° lower than that employed in the above experiment, what we require to settle the question is, not thousands of quite different experiments, whose results one way or the other cannot settle the point at issue; but a repetition of the same experiments by other observers with the object of detecting the fallacy, if any, that lurks in them.

The only other article we can here refer to, is that on "The Law of Likeness and its Working," which deals with the question of heredity, and Mr. Darwin's theory of Pangenesis. But no notice is taken of Mr. Francis Galton's very important "Theory of Heredity," published in the *Journal of the Anthropological Institute*, vol. v. p. 329; which, though it may be considered as a mere modification of that of Mr. Darwin, really differs from it in many important points, and affords a more complete and satisfactory explanation of many of the most curious facts; such as the *unlikeness* of children to their parents, the appearance of diseases and even of mental qualities, in alternate generations, and many others. Every one wishing to comprehend this most difficult yet most interesting subject, should study Mr. Galton's paper as a necessary supplement to the theory of Pangenesis.

At p. 70 of Dr. Wilson's book, a letter from the *Times* is quoted, describing the formation of the bees' cell, as due entirely to the *pressure* of opposing bees in adjacent cells. This is not strictly correct; and Mr. Darwin's observations should have been referred to, showing that the cell-walls are first built very thick, and are *gnawed* down to the requisite thinness. There is also some obscurity in the suggested explanation of the "apparent movement" of the crocodile's upper jaw, when it opens its mouth. The fact appears to be that the crocodile, opening

its mouth when on land, *must* raise its upper jaw and head (by bending the neck) simply because the lower jaw has not room to move downwards. The movement of the upper jaw is therefore, under these circumstances, real, and not only "apparent" as stated. One of the most interesting chapters is that on "Animals and their Environments," in which an account is given of the curious changes during the growth of flat fishes, and the still more remarkable phenomena which have been recently observed in the metamorphoses of the axolotl, and the alpine salamander.

A. R. W.

OUR BOOK SHELF

An American Geological Railway Guide, giving the Geological Formation at every Railway Station; with Notes on interesting Places on the Routes, and a Description of each of the Formations. By James Macfarlane, Ph.D. (New York: Appleton and Co., 1879.)

DR. MACFARLANE has added a new pleasure to railway travelling, or rather, by means of this geological guide-book, he has done much to make it both enjoyable and instructive. The idea of the book is excellent, and the plan seems to us thoroughly satisfactory. Now that we have this manageable little flexible book before us, it seems strange that such a guide has not been thought of before, but perhaps not so strange that our enterprising friends on the other side should set an example to their Old-World brethren. We believe the prospectus of some such guide was issued in this country several months ago; if so, we recommend its compilers to obtain a copy of Dr. Macfarlane's book, and take several leaves out of it. If no such work is being prepared for the forlorn traveller of our islands, we advise some of our Survey-men to lay their knowledge together, and produce a similar guide as speedily as possible; they will be doing a public service, and if the result is as satisfactory as in the case of the book before us, they will, we feel confident, reap something more substantial than thanks. In compiling his tables, Dr. Macfarlane has had the assistance of some of the most eminent geologists in the States, and some of the information has not before been published. The tables are very similar to railway time-tables, having on the left hand side of the names of the stations, the miles between each, and on the right, instead of the times, the names of the leading formation to be seen along the route. The tables are so constructed as to be useful for a continuous journey through the States in any direction, and, at the same time, to give an idea of the leading geological characteristics of each state. Appended is an index to railroads, and a general geological map of the States. Prefixed are about fifty pages of instructive information, consisting mainly of methodical descriptions of the various formations of North America, and containing Dana's and Hunt's tables of formations. By carefully studying this the traveller will be in a fair position to profit by the tables, and by the faithful use of these much practical knowledge of geology may be acquired even by the ignorant, while to the geologist they will be a constant source of enjoyment; the handy volume is much more easily managed than a map. We may state that the tables refer to Canada as well as the States.

Comment le font les Miracles en dehors de l'Église.
Wilfrid de Fonvielle. (Paris: Dreyfous.)

WHY does not M. Dreyfous date his books? We are sure M. de Fonvielle cannot have noticed the suspicious omission. M. de Fonvielle is already pretty well known in France as a popular gossip on what may be called the eccentricities of science. The present volume is quite equal in interest to anything he has published, and is likely, we should think, to be widely read in France. It